FINAL

PROPOSED PLAN FOR THE INTERIM RECORD OF DECISION AT OPERABLE UNIT 6 FOR RSA-55/54 CLOSED SANITARY AND INDUSTRIAL LANDFILL REDSTONE ARSENAL, ALABAMA

ISSUED BY: U.S. ARMY AVIATION AND MISSILE COMMAND

OCTOBER 1997

INTRODUCTION

This Proposed Plan identifies the preferred alternative for addressing contamination at a closed sanitary and industrial landfill at Redstone Arsenal in Madison County, Alabama. The location of Redstone Arsenal is shown in Figure 1. In addition, the Proposed Plan provides site background information and a summary of the other alternatives considered in the selection process. The closed sanitary and industrial landfill will be identified throughout this document by the site designator RSA-55/54.

This document is issued by the U.S. Army Aviation and Missile Command (AMCOM), the lead agency for environmental response actions at Redstone Arsenal, in partnership with the U.S. Environmental Protection Agency (EPA) and the Alabama Department of Environmental Management (ADEM), both support agencies for response actions at Redstone Arsenal. As the lead agency, the AMCOM is charged with planning and implementing remedial actions at the arsenal. The support agencies assist the lead agency by providing regulatory review, comment, and oversight. The AMCOM, in partnership with the EPA and the ADEM, will select an interim remedy for RSA-55/54 after the public has had an opportunity to comment on this Proposed Plan and all comments received have been reviewed and considered. The interim remedy selected for RSA-55/54 will be documented in an Interim Record of Decision.

The AMCOM is issuing this Proposed Plan for public comment and participation to fulfill part of its public participation responsibilities under Section 117(a), 113(k)(2)(B), and 121(f)(1)(G) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986.

The Proposed Plan presents an **interim** remedy because an assessment has yet to be completed to determine potential cumulative risks to wildlife exposed to contaminants present at all sites within Operable Unit 6. Once an operable unit-wide ecological risk assessment is performed, a **final** remedy will be selected after the public has had an opportunity to comment. It is intended that the interim remedy, once selected, should be consistent with the final remedy for RSA-55/54.

This document summarizes information presented in greater detail in the Phase I and Phase II Resource Conservation and Recovery Act (RCRA) facility investigation reports, baseline risk assessment, feasibility study, and other documents contained in the administrative record file for RSA-55/54. The AMCOM, the EPA, and the ADEM encourage the public to review these documents in order to gain a more comprehensive understanding of RSA-55/54 and the CERCLA activities that have been conducted there. A copy of the administrative record file, which contains information upon which the selection of the response action will be based, is available at the public repositories listed on page 2.

The public is encouraged to review and comment on all the remedial alternatives identified in the Proposed Plan. Based on new information or comments received during the public comment period, the AMCOM, in partnership with the EPA and the ADEM, may modify the Proposed Plan or consider other response actions. This would occur only after the public comment period has ended.

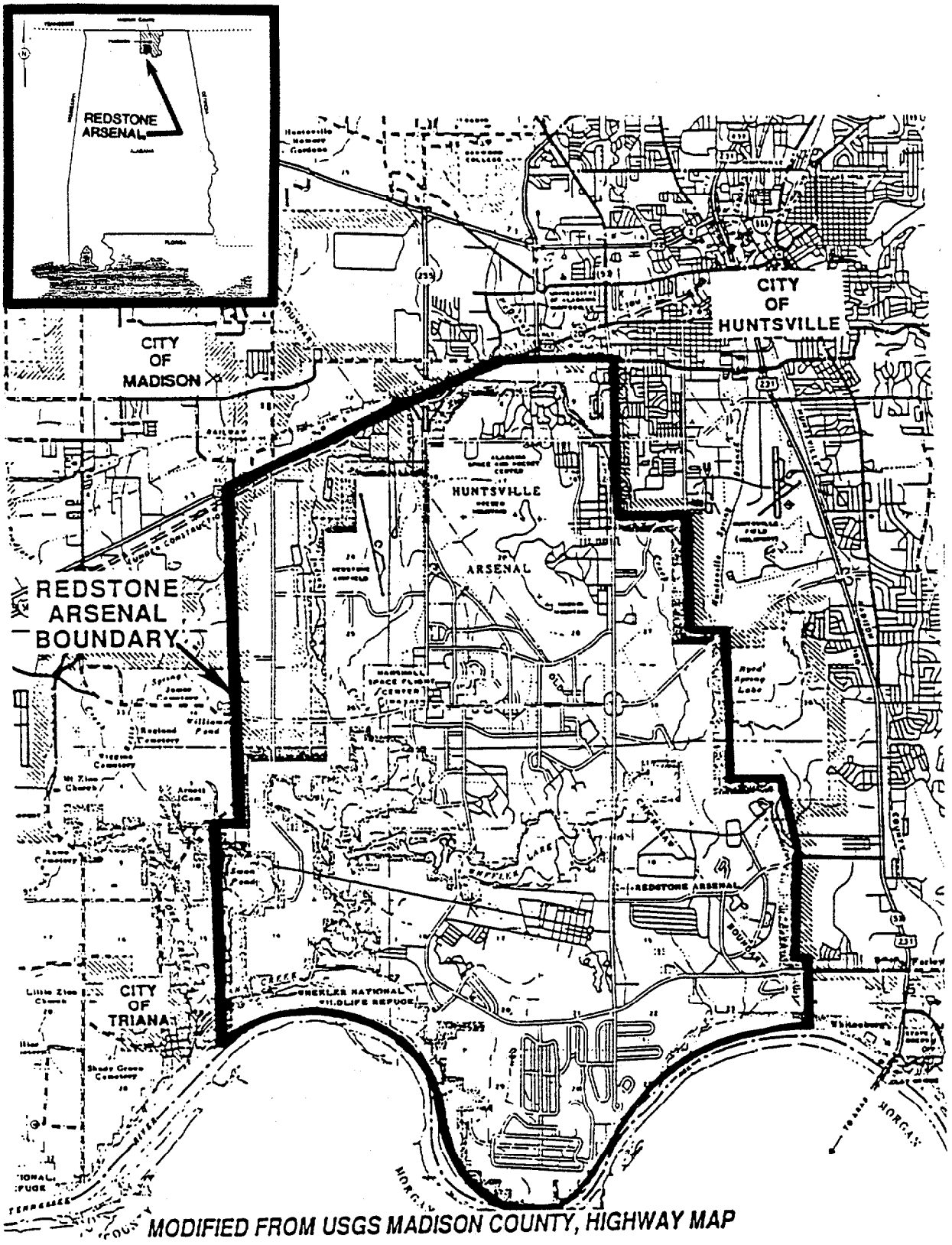

FIGURE 1
LOCATION OF REDSTONE ARSENAL
REDSTONE ARSENAL - MADISON COUNTY, ALABAMA

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Public Repositories for the Administrative Record File for RSA-55/54

U.S. Army Aviation and Missile Command, Redstone Arsenal, Alabama

Contact:	Ms. Terry de la Paz (205) 955-6968
Location:	Environmental Management and Planning Office - Building 112
Business Hours:	Mon.-Fri. (7:00-4:30)
Contact:	Mr. Mike Baker (205) 842-0564
Location:	Redstone Arsenal Historical Office - Sparkman Center, Room 5135
Business Hours:	Mon.-Fri. (7:00-4:30)
Contact:	Ms. Jean Bannister (205) 876-9309
Location:	Redstone Arsenal Scientific Library - Building 4484 (Martin Road)
Business Hours:	Mon. (8:00-4:30), Tues.-Fri (8:00-7:00), Sat. (8:00-4:00)

Huntsville/Madison County Public Library

Contact:	Ms. Anne Fuller (205) 532-5969
Location:	Huntsville/Madison County Public Library - Heritage Room 915 Monroe Street Huntsville, Alabama
Business Hours:	Mon.-Thurs (9:00-9:00), Fri.-Sat. (9:00-5:00), Sun. (1:00-5:00)

Triana Public Library

Contact:	Ms. Patricia Washington (205) 461-7598
Location:	Triana Public Library (Triana Youth Center) 280 Zierdt Road Triana, Alabama 35758
Business Hours:	Mon.-Fri. (10:30-3:30)

Comments can be directed to:

Commander
U.S. Army Aviation and Missile Command
Attn: AMSAM-PA
(Ms. Pam Rogers)
Redstone Arsenal, Alabama
35898-5020

Tel: (205) 842-0561
Fax: (205) 955-0133
E-mail: "rogers-ps@redstone.army.mil"

SITE BACKGROUND

RSA-55/54 is centrally located within Redstone Arsenal (Figure 2), immediately west of McMorrow Labs (Building 5400). The area comprises a single landfill occupying approximately 18 acres and is bounded on the west by Mills Road, on the north by Martin Road, and on the east by Lindner Road. Fowler Road, constructed after the landfill was operable, bisects RSA-55/54 (Figure 3) and forms an artificial boundary between RSA-55 and RSA-54. RSA-55, containing approximately 5 acres, represents the portion that is south of Fowler Road. RSA-54 represents the remaining portion of the landfill north of Fowler Road and contains approximately 13 acres.

The landfill was used during the 1960s and early 1970s for disposal of household, administrative, and industrial waste. Wastes were disposed in trenches that were later covered with a thin layer of soil. Wastes containing the banned pesticide 4,4'-dichloro-diphenyltrichloroethane (DDT) were buried at various locations in the

DATES TO REMEMBER

Oct. 20 to Nov. 18, 1997
Public Comment Period on the Proposed Plan for RSA-55/54.

November 4, 1997
Public Meeting at Huntsville/Madison County Public Library, 915 Monroe Street, Huntsville, AL
4-6 p.m.

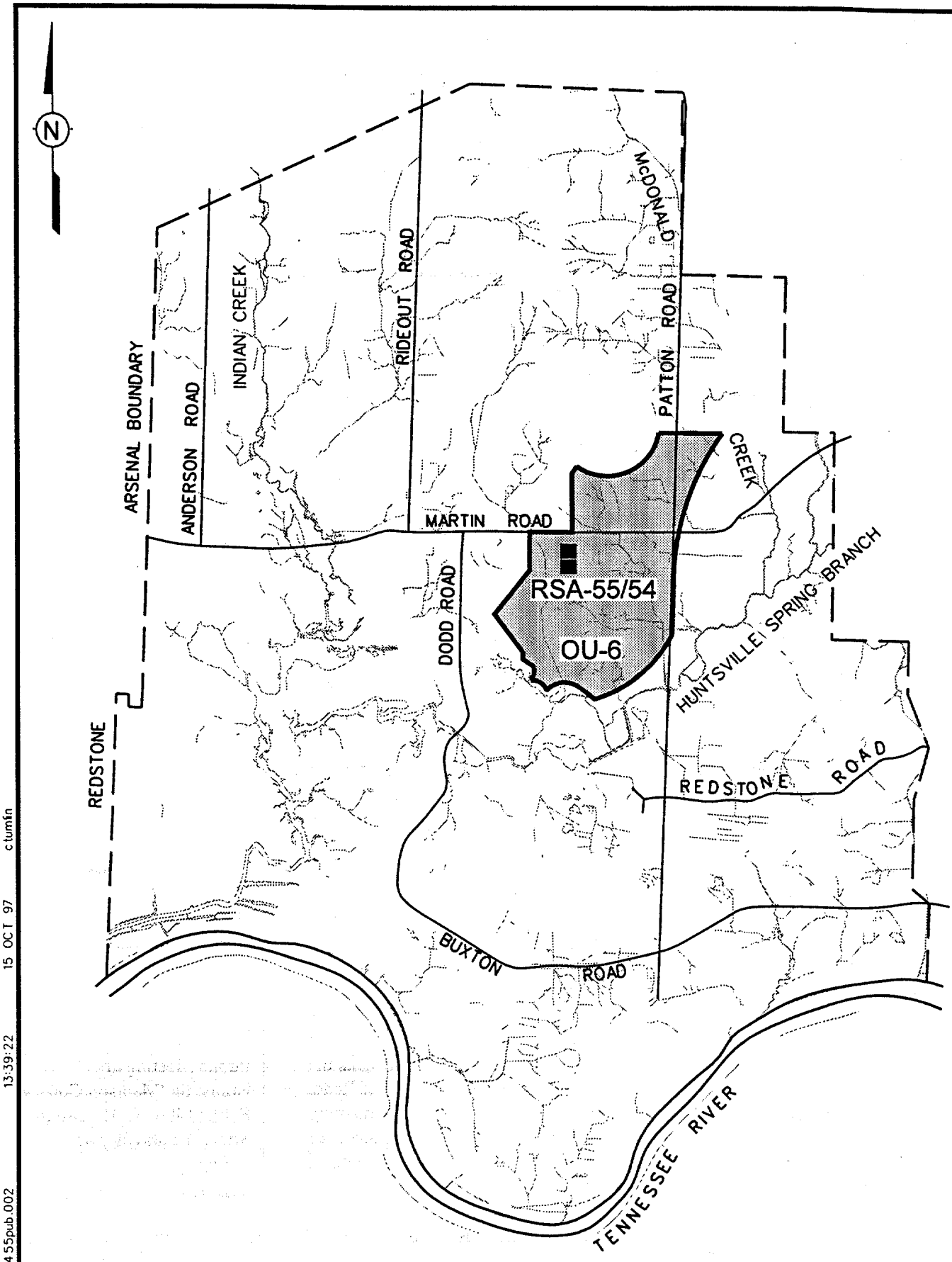

FIGURE 2
LOCATION OF RSA-55/54 WITHIN REDSTONE ARSENAL
REDSTONE ARSENAL - MADISON COUNTY, ALABAMA

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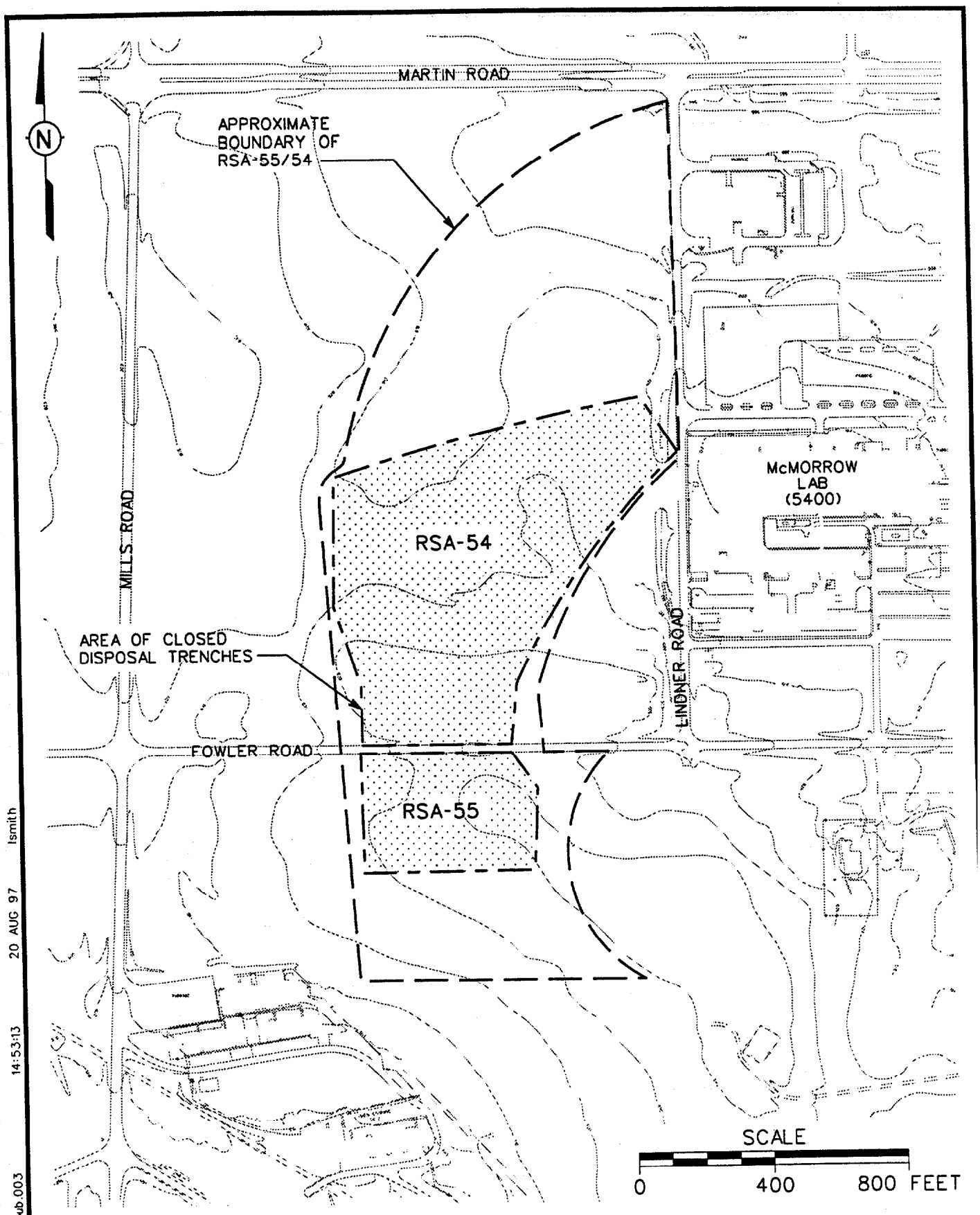

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FIGURE 3
RSA-55/54 CLOSED SANITARY AND INDUSTRIAL LANDFILL SITE LOCATION
REDSTONE ARSENAL - MADISON COUNTY, ALABAMA

Primary Background Documents for RSA-55/54

Geraghty & Miller, 1992, ***Final Phase I Report, RCRA Facility Investigations at Unit 1, Unit 2, and Selected Unit 3 Areas, Redstone Arsenal, Alabama***, Volumes I and II, May 1992.

Geraghty & Miller, 1993, ***Final Phase II Addendum, RCRA Facility Investigations at Unit 1, Unit 2, and Selected Unit 3 Areas, Redstone Arsenal, Alabama***, April 1993.

Environmental Science and Engineering, Inc., 1995, ***Draft-Final Baseline Risk Assessment for RSA-48, 49, 55/54, and 59, Redstone Arsenal, Alabama***, July 1995.

Environmental Science and Engineering, Inc., 1997, ***Draft-Final Feasibility Study for RSA-49 and RSA-55/54, Redstone Arsenal, Alabama***, Environmental Science and Engineering, Inc., February 1997.

landfill between 1968 and 1973. These wastes were later excavated and reburied in the DDT Waste Soils Landfill at RSA-107 under the Redstone Arsenal DDT Migration Abatement Program conducted from 1977 to 1982.

The RCRA facility investigations conducted in 1991 and 1992 identified concentrations of hazardous substances above regulatory risk-based screening criteria in the upper groundwater aquifer at the site. Hazardous substances were not detected above regulatory risk-based screening criteria in the underlying bedrock aquifer. Concentrations of hazardous substances in the upper aquifer decreased with depth, indicating the potential source of groundwater contamination was the former disposal trenches in the southwest corner of RSA-54. Table 1 presents a summary of contaminants detected in groundwater at concentrations greater than federal and state drinking water standards.

In soil, three polyaromatic hydrocarbons (benzo[a]anthracene, benzo[a]pyrene, and dibenzo[a,h]anthracene), and two pesticides (dichlorodiphenyl dichloroethane and DDT) were detected at concentrations above regulatory risk-based screening criteria.

A more detailed description of the nature and extent of contamination at RSA-55/54 is presented in the Phase I and Phase II RCRA facility investigation reports.

SCOPE AND ROLE OF OPERABLE UNIT

Each area under investigation for potential contamination at Redstone Arsenal, such as this closed sanitary and industrial landfill, is classified as a site with an associated site designator (such as RSA-55/54). Individual sites are further grouped into operable units to facilitate the assessment of potential risks to human health and ecological receptors. Eighteen operable units have been defined at Redstone Arsenal. RSA-55/54 is part of Operable Unit 6.

Operable Unit 6 also includes the following sites:

- RSA-E - Product Spill at Fuel Tank Farm
- RSA-F - Open Storage 54-1
- RSA-10 - Active Sanitary Landfill
- RSA-53 - Inactive Sanitary Landfill
- RSA-56 - Former Arsenic Ponds South
- RSA-57 - Former Lewisite Storage Area
- RSA-59 - Inactive Rubble Fill
- RSA-60 - Inactive Sanitary Landfill
- RSA-104 - Former GAF Discharge Area
- RSA-117 - Former Liquid Caustic Plant
- RSA-118 - Former GAF Ammonia Lagoon
- RSA-122 - WWII Lewisite Manufacturing Facility Site
- RSA-126 - Former Burn Trench
- RSA-139 - Arsenic Waste Lagoon
- MSFC-74 - Former Disposal Area in Marshall Space Flight Center.

This Proposed Plan addresses the contaminated soil and groundwater at RSA-55/54. The remedial objectives for RSA-55/54 are to prevent current and future exposures to contaminated soil and groundwater that exceed acceptable risk-based levels.

Table 1

Summary of Groundwater Contamination
Closed Sanitary and Industrial Landfill (RSA-55/54)
Redstone Arsenal, Madison County, Alabama

Constituent	Detections/Samples	Concentration Range (µg/L)	MCL (µg/L)
Benzene	5/29	ND - 31	5
Chlorobenzene	10/33	ND - 3,000	100
Trichloroethene	6/33	ND - 25	5
Vinyl chloride	2/29	ND - 46	2
Cadmium	3/29	ND - 7.8	5
Lead	15/29	ND - 204	15

Notes: MCL - Maximum contaminant level permissible for drinking water.
ND - Not detected.

SUMMARY OF SITE RISKS

A human health and ecological risk assessment was performed for RSA-55/54 and presented in the *Draft-Final Baseline Risk Assessment for RSA-48, 49, 54/55, and 59*. The objective of the risk assessment was to provide the framework for developing risk information necessary to assist in making decisions about the site. The human health and ecological risk assessment evaluated the potential health impacts of contaminants detected in soil, groundwater, surface water, and sediment on exposed and potentially exposed human populations and ecological receptors if no action is taken to remedy conditions at RSA-55/54.

The current industrial use of the installation will continue into the future as the Army does not intend to change the current mission of Redstone Arsenal. The potential for residential development of RSA-55/54 is, therefore, extremely unlikely. There are no buildings located directly on RSA-55/54 and the landfill would not provide the necessary support for large structures (residences, offices). Although the possibility for future industrial and residential use of RSA-55/54 is unlikely, hypothetical future exposures were evaluated to provide a perspective on the level of contamination at the site. Although access to Redstone Arsenal is generally restricted, hunting and fishing are permitted in some areas of the installation.

Human Health Assessment

During the human health risk assessment, three types of individuals (receptors) were identified as having potential exposures to contaminants at RSA-55/54: a worker who currently maintains the grounds at the site, a future worker (also groundskeeper), and a recreational user of the arsenal (hunter) who might trespass on RSA-55/54. Each of these receptors could be exposed to either contaminated soil or groundwater through a number of different exposure pathways. The following soil and groundwater exposure pathways were identified for each receptor:

- **Current Worker.** A current worker may be exposed to contaminated soil through the following pathways: incidental ingestion of soil, inhalation of dust, or direct skin contact with soil. A current worker would not be exposed to contaminated groundwater because Redstone Arsenal presently obtains all drinking water from the Tennessee River.

- **Future Worker.** Soil exposure pathways for a future worker are the same as those identified for a current worker. However, unlike the current worker, future worker exposure to contaminated groundwater was evaluated because groundwater could theoretically be used as a future source of potable water. To be conservative, groundwater concentration data from the upper aquifer at the site was used in risk calculations, despite the fact that this aquifer is not a viable source of drinking water due to its poor yield. A worker could be exposed to contaminants in groundwater through the following pathways:

ingestion of groundwater, inhalation of volatile organic compounds in groundwater, and direct skin contact with groundwater.

- **Recreational User.** The recreational user exposure pathways for soil and groundwater are the same as those identified for the current worker. However, the recreational user would only be exposed to soils for a small number of days each year.

Human health risks from potential carcinogens (cancer-causing chemicals) were estimated as probabilities of individuals developing cancer as a result of exposure to chemicals from the site. The risks from each exposure pathway (described previously) were summed to calculate the combined risks to an individual for each type of exposure. EPA has determined that a cancer risk range of 10^{-6} to 10^{-4} is generally considered to be acceptable. A cancer risk of 10^{-6} means that one person out of one million is at risk of developing cancer if the site is not cleaned up. A human health risk greater than 10^{-4}, or one in ten thousand, is considered unacceptable.

Noncancer human health effects are characterized by evaluating the ratio of the long-term dose known to cause an adverse health effect to the long-term daily intake estimated for a specific chemical. This ratio is called the hazard quotient. The sum of the hazard quotients for all chemicals is the hazard index for a particular type of exposure. A hazard index greater than 1.0 generally indicates that the acceptable exposure threshold for a particular chemical or type of exposure has been exceeded.

The results of the human health risk assessment are summarized in Table 2. From Table 2, it can be seen that total cancer risks were within acceptable levels for all the receptors evaluated. The noncancer hazard indices for the current worker and future worker exposed to surface soils are within acceptable limits. The noncancer hazard index for future workers exposed to groundwater slightly exceeds acceptable levels. The major contributors to the unacceptable hazard index are benzene and chlorobenzene.

Table 2

Summary of Site Risks and Hazards
RSA-55/54
Redstone Arsenal, Madison County, Alabama

Receptor/Medium	Total Cancer Risk	Total Noncancer Hazard Index[a]	Risk Drivers[b]
Current worker/Surface soil	2.0×10^{-9}	3.0×10^{-5}	None
Current worker/Groundwater	No current exposure		None
Future worker/Surface soil	4.0×10^{-5}	6.0×10^{-5}	None
Future worker/Groundwater	8.0×10^{-5}	2.0	Chlorobenzene, Benzene
Future recreational user/Surface soil	Less than future worker		None
Future recreational user/ Groundwater	Less than future worker		None

[a]Shaded cells indicate unacceptable cancer risk (greater than 10^{-4}) or noncancer hazard index (greater than 1.0).
[b]For exposures with unacceptable risk or hazard, the chemicals that are primary contributors are listed.

Ecological Assessment

The ecological risk assessment evaluated the potential exposure of land-based wildlife to chemicals in surface soil. Endangered species are unlikely to occur in the immediate area of RSA-55/54 due to a lack of suitable or critical habitats. Small and large mammals and birds (e.g., mouse, raccoon, deer, and bobwhite) are the primary receptors that would be exposed to contaminated soil from RSA-55/54.

A screening risk analysis was conducted to address ecological risks and involved using the ecotoxicity quotient, which is the ratio of the estimated exposure concentration to the concentration in literature reported to cause an adverse effect. Values less than 1.0 are considered to be acceptable. All ecotoxicity quotients were less than 1.0; there-

fore, potential exposures to surface soil associated with RSA-55/54 will not result in an unacceptable risk.

Risk Summary

The actual or threatened release of hazardous substances from surface soils at RSA-55/54 do not indicate an imminent and substantial or future endangerment to public health and welfare or the environment. Therefore, no remedial action is required for RSA-55/54 soils.

However, the noncancer hazard index for potential future worker exposures to groundwater is marginally unacceptable. The worker exposures to groundwater were calculated using data from the upper aquifer at RSA-55/54. This aquifer is not a viable source of drinking water due to its low yield. Nevertheless, in order to ensure protection of human and health and the environment, it was determined that further action should be considered, and a feasibility study was performed to evaluate a variety of potential remedial alternatives.

During the feasibility study, remedial goals were established to define acceptable concentrations of contaminants that provide adequate protection for human health and the environment. Because current and future land use at Redstone Arsenal is expected to be industrial/-commercial, remedial goals were calculated based on estimated exposures of future site workers. The remedial goals for RSA-55/54 are summarized in Table 3.

Table 3

Remedial Goals for Contaminants in Groundwater
RSA-55/54
Redstone Arsenal, Madison County, Alabama

Chemical of Concern	Source-Term Concentration[a] (µg/L)	Remedial Goal (µg/L)	Basis for Remedial Goal
Benzene	5.8	0.25	Based on a Hazard Index of 0.1
Lead[b]	21	15	EPA Action Level
Chlorobenzene	350	24	Based on a Hazard Index of 0.1

[a]Source-term concentration represents a conservative estimate of the average concentration of the constituent in groundwater.
[b]The remedial goal for lead is the EPA action level. There is no toxicological value upon which to develop a remedial goal based on carcinogenic or noncancer health effects.

SUMMARY OF ALTERNATIVES

The feasibility study presented an evaluation of six remedial alternatives, defined below as Alternatives 1 through 6, for addressing contamination at RSA-55/54. Alternative 7 is an additional alternative not included in the feasibility study. The inclusion of Alternative 7 satisfies a U.S. Army requirement to evaluate natural attenuation as a remedial option at Army installations.

Alternative 1: Pretreatment

- Estimated Construction Cost: $125,000
- Estimated Annual O&M Costs: $61,000
- Estimated Present Worth Cost: $523,000
- Estimated Implementation Time Frame: 2 years
- Estimated Remedial Duration: 6 years.

Treatment Component:

The pretreatment alternative for RSA-55/54 consists of a groundwater extraction and treatment system designed to reduce the concentrations of contaminants in groundwater to remedial goals. The extraction and treatment system would involve a network of approximately 11 wells screened to extract groundwater from the upper aquifer. The groundwater pretreatment system would be comprised of air stripping to remove volatile organic compounds and media filtration for suspended solids removal. A solids slurry generated from backwashing the media filters would be further concentrated into a dry filter cake requiring disposal at an approved landfill. The pretreatment system would be designed to comply with Alabama Water Quality Criteria because the treated

groundwater would be discharged to nearby surface waters.

Engineering Controls:
None.

Institutional Controls:
Groundwater would be monitored quarterly during the period of remedial action.

Alternative 2: Capping

- Estimated Capital Cost: $2,755,000
- Estimated Annual O&M Costs: $33,000
- Estimated Present Worth Cost: $ 4,704,000
- Estimated Implementation Time Frame: 2 years
- Estimated Remedial Duration: 30 years.

Treatment Component:
None.

Engineering Controls:
Alternative 2 includes construction of an approximately 960,000-square-foot, low-permeability, RCRA "Subtitle C" cap over the closed sanitary and industrial landfill at RSA-55/54. This response action would provide contaminant source control by minimizing infiltration of incident rainfall into the buried waste, thus minimizing further contaminant migration to groundwater. A new perimeter fence and gate would be erected to prohibit entry into the area by unauthorized individuals.

Institutional Controls:
A 30-year groundwater monitoring program would be implemented to evaluate the effectiveness of the cap. Monitoring would consist of sampling nine perimeter wells. Monitoring frequency would be quarterly for years 1 and 2; semi-annually for years 3, 4, and 5; and annually for years 6 through 30. Maintenance of the cap would also be provided during this period.

Alternative 3: Groundwater Monitoring

- Estimated Construction Cost: $73,000
- Estimated Annual O&M Costs: $4,800
- Estimated Present Worth Cost: $202,000
- Estimated Implementation Time Frame: 1 year
- Estimated Remedial Duration: 30 years.

Treatment Component:
None.

Engineering Controls:
Alternative 3 includes the erection of a new perimeter fence around the site and posting of warning signs as a notification that groundwater in the area is contaminated and is not to be used for any purpose.

Institutional Controls:
Alternative 3 includes long-term groundwater monitoring at RSA-55/54 during an estimated 30-year period. The monitoring program would involve analyzing groundwater from selected wells for lead and volatile organic compounds, including benzene and chlorobenzene. The monitoring wells would be placed between the contaminated groundwater and the location of any potential human or ecological receptors. The monitoring frequency would be quarterly for the first 2 years, semiannually for years 3 through 6, and annually thereafter.

Alternative 3 would also include a contingency remedy to prevent the spread of groundwater contamination if monitoring data indicate contamination is nearing exposure points for human or ecological receptors. If groundwater data indicates that remedial goals are being exceeded on a continuing basis, additional remedial efforts would be implemented to ensure protection of human health and the environment. The contingency remedy would be defined after the decision is made to take additional action at RSA-55/54.

Alternative 4: Institutional Controls

- Estimated Construction Cost: $75,000
- Estimated Annual O&M Costs: $2,900
- Estimated Present Worth Cost: $160,000
- Estimated Implementation Time Frame: 1 year
- Estimated Remedial Duration: 30 years.

Treatment Component:
None.

Engineering Controls:
The alternative includes the erection of a perimeter fence around each landfill. Fowler Road would remain open and would continue to be maintained. Signs would be posted around the perimeter of the site as a notification that the groundwater in this area is contaminated and is not to be used for any purpose.

Institutional Controls:
This alternative involves implementation of administrative controls that would restrict groundwater use at RSA-55/54. The Redstone Arsenal Master Plan would be modified to prohibit the installation of drinking water wells within the contaminated plume. Periodic inspections would be conducted to verify compliance with the groundwater use restrictions.

Alternative 5: Institutional Controls and Groundwater Monitoring

- Estimated Construction Cost: $75,000
- Estimated Annual O&M Costs: $7,700
- Estimated Present Worth Cost: $251,000
- Estimated Implementation Time Frame: 1 year
- Estimated Remedial Duration: 30 years.

Treatment Component:
None.

Engineering Controls:
The alternative includes the erection of a perimeter fence around each landfill. Fowler Road would remain open and would continue to be maintained. Signs would be posted around the perimeter of the site as a notification that the groundwater in this area is contaminated and is not to be used for any purpose.

Institutional Controls:
Alternative 5 combines the land-use restrictions of Alternative 4 with the long-term groundwater monitoring plan and contingency remedy described in Alternative 3.

Alternative 6: No Action

- Estimated Construction Cost: $0
- Estimated Annual O&M Costs: $0
- Estimated Present Worth Cost: $0
- Estimated Implementation Time Frame: None
- Estimated Remedial Duration: None.

Treatment Component:
None.

Engineering Controls:
None.

Institutional Controls:
None.

The CERCLA program requires that the "no-action" alternative be evaluated to establish a baseline for comparison of other alternatives. Under this alternative, the AMCOM would take no further action at RSA-55/54 to investigate, clean up, or monitor the site.

Alternative 7: Natural Attenuation

- Estimated Construction Cost: $73,000
- Estimated Annual O&M Costs: $8,900
- Estimated Present Worth Cost: $327,000
- Estimated Implementation Time Frame: 2 years
- Estimated Remedial Duration: 30 years.

Treatment Component:
None.

Engineering Controls:
Alternative 7 includes the erection of a new perimeter fence around the site and posting of warning signs as a notification that groundwater in the area is contaminated and is not to be used for any purpose.

Institutional Controls:
Alternative 7 includes the data collection and analysis required to demonstrate that natural attenuation mechanisms, without the assistance of any active remedial effort, would reduce the concentration of contaminants in groundwater to remedial goals before humans or environmental receptors are endangered. Natural attenuation mechanisms include intrinsic processes such as biodegradation, dispersion, dilution, sorption and volatilization. Additional groundwater data would be collected to support a decision on the viability of natural attenuation at RSA-55/54. Groundwater modeling would be used to predict concentration profiles for contaminants in groundwater over time. The modeling results would be used to predict whether humans or ecological receptors would be exposed to concentrations of contaminants above remedial goals.

A long-term groundwater monitoring plan like the one described in Alternative 3 would be implemented to verify the conclusions of the natural attenuation analysis. The monitoring wells would be placed between the contaminated groundwater and the location of any potential human or ecological receptors. Monitoring frequency would be quarterly for the first 2 years, semiannually for 3 years through 6 years, and annually thereafter for a period of up to 30 years.

Alternative 7 would include a contingency remedy, as in Alternative 3, to be implemented if groundwater monitoring data indicate that contaminant migration is endangering human or environmental receptors. Alternative 7 would also involve modifying the Redstone Arsenal Master Plan to prohibit the installation of drinking water wells within the contaminated groundwater plume.

EVALUATION OF ALTERNATIVES

Each alternative was evaluated according to the following criteria, based on the EPA-approved feasibility study work plan:

- Technical Evaluation - including performance, reliability,

implementability, and safety of the alternative

- Environmental Evaluation - including short- and long-term beneficial and adverse effects, adverse effects on the environmentally sensitive areas, and analysis of measures to mitigate adverse effects

- Human Health Evaluation - including levels and characterization of contaminants, potential exposure routes, and potentially affected populations

- Institutional Evaluation - including the effects of regulations and community relations on the design, operation, or scheduling of the alternative

- Cost Evaluation - including capital costs (both direct and indirect) and operation and maintenance costs.

The final two evaluation criteria, state and community acceptance, will be discussed in the Interim Record of Decision after the public comment period has ended.

The preferred remedial alternative for RSA-55/54 is:

Alternative 5 - Institutional Controls and Groundwater Monitoring

Based on current information, Alternative 5 is recommended as providing the best balance in achieving the goals of the five evaluation criteria.

Based on new information or public comments, the AMCOM, in partnership with the EPA and the ADEM, may later modify the preferred alternative or select another remedial alternative. The public, therefore, is encouraged to review and comment on all the alternatives presented in the proposed plan.

The remaining portions of this section profile the performance of the preferred alternative against the five criteria, comparing it with the other alternatives under consideration. The feasibility study provides a more detailed explanation of the comparative analysis of alternatives.

Technical Evaluation

The preferred Alternative 5 and Alternatives 1 and 7 achieve both of the remedial action objectives for groundwater at RSA-55/54 (eliminate unacceptable risk to future on-site workers and minimize risk to off-site receptors). Alternatives 2, 3, and 4 achieve only one objective, and Alternative 6 achieves none of the remedial action objectives.

Alternatives 1 through 7 are readily implemented and reliable, in that they require no special technologies. Equipment and materials are readily available from vendors. Alternatives 1, 2, and 7 would require up to 2 years to implement, while the other alternatives would require approximately 12 months.

The operation and maintenance requirements of Alternative 1 are high; Alternative 2 are moderate; and Alternatives 3, 4, 5, and 7 are low.

Environmental Evaluation

Alternative 1 would contain the migration of contaminants to environmentally sensitive areas through groundwater extraction and treatment.

Alternative 2 would mitigate impacts on environmental receptors by minimizing the leaching of contaminants from soil to groundwater. Alternative 2 also includes a groundwater monitoring program to detect contamination before it migrates to environmentally sensitive areas.

Alternatives 3, 5, and 7 would protect environmentally sensitive areas by the implementation of a groundwater monitoring program that would trigger further remedial efforts should contaminants be detected near sensitive ecosystems at concentrations above risk-based action levels.

Neither Alternative 4 nor 6 involve any active measures to protect environmentally sensitive areas.

Human Health Evaluation

The preferred Alternative 5 and Alternative 7 would prevent future exposure of workers to contaminated groundwater from RSA-55/54 through the imposition of restrictions to its use within the arsenal. Off-site receptors would be protected from exposure because monitoring wells would be established to detect contaminants and trigger additional remedial efforts in the unlikely event contaminants would migrate significant distances from RSA-55/54 at concentrations high enough to cause unacceptable human health risks.

Alternatives 1, 2, and 3 would provide protection for off-site receptors, but would not restrict the use of groundwater within the arsenal to protect a future worker.

Alternative 4 would protect future RSA-55/54 workers, but provides no protection for off-site receptors.

Alternative 6 provides no human health protections.

Institutional Evaluation

Alternative 1 would comply with all state and federal regulations with the exception of RCRA requirements for landfill closure. These requirements include construction of a landfill cover that minimizes migration of liquids through the closed landfill, promotes drainage and minimizes erosion or abrasion of the cover, accommodates settling and subsidence, and functions with minimum maintenance. Although these requirements are not directly applicable because the landfill did not operate under a RCRA permit, the requirements could be construed to be relevant and appropriate.

Alternative 2 would comply with all state and federal requirements except for the provisions of the Alabama Ground Water Protection Program. Current levels of contaminants in groundwater are greater than Alabama Primary Drinking Water Standards, and would remain so under this alternative. However, the alternative includes a groundwater monitoring program to detect the continued migration of contaminants. Additional remedial actions would be implemented if contaminants were detected at compliance monitoring wells at concentrations above risk-based action levels.

Alternatives 3, 4, 5, 6, and 7 would not meet either RCRA landfill closure requirements or the provisions of the Alabama Primary Drinking Water Program as previously discussed. However, Alternatives 3, 5, and 7 would provide institutional controls that would prevent RSA-55/54 workers from drinking contaminated groundwater from the site. Alternatives 4, 5, and 7 would implement a groundwater monitoring program to detect the continued migration of contaminants. A contingency remedy would be implemented if contaminants were detected at compliance monitoring wells at concentrations above risk-based action levels, thereby preventing individuals outside the arsenal from drinking contaminated groundwater.

Cost Evaluation

The present-worth costs for the alternatives are as follow:

Alternative 1:	$523,000
Alternative 2:	$4,704,000
Alternative 3:	$202,000
Alternative 4:	$160,000
Alternative 5:	$251,000
Alternative 6:	$0
Alternative 7:	$327,000.

SUMMARY

The Alternative 5 - Institutional Controls and Groundwater Monitoring is the preferred alternative for addressing contamination at RSA-55/54 because this alternative achieves all the remedial action objectives for the site at the lowest cost. Institutional controls would restrict the future use of the contaminated groundwater on the arsenal and protect RSA-55/54 workers.

The combination of long-term groundwater monitoring with the option to implement a continency remedy in the future would protect off-site individuals and environmental receptors from exposure to contaminated groundwater. The contingency remedy would involve the implementation of additional remedial measures in the unlikely event that contaminants would migrate significant distances from the RSA-55/54 at concentrations high enough to cause unacceptable human health risks or significant damage to sensitive ecosystems.

Although some of the other alternatives would employ more aggressive measures (e.g., capping, pump and treat) to address groundwater contamination at RSA-55/54, the additional costs associated with these alternatives are unlikely to provide any incremental benefit. The probability that contaminated groundwater from RSA-55/54 will adversely impact human receptors or environmentally sensitive areas is negligible for the following reasons:

- Groundwater is not currently used for drinking water at Redstone Arsenal and there are no future plans to use it for drinking water. Drinking water for the arsenal is supplied from the Tennessee River.

- Contaminated groundwater at RSA-55/54 is distant from off-site human receptors and environmentally sensitive areas. The nearest wetlands area is approximately 0.7 miles east of RSA-55/54 and the closest arsenal boundary where individuals could establish drinking water wells off site is approximately 2.3 miles from RSA-55/54.

- Currently, groundwater contamination appears to be restricted to the upper aquifer at RSA-55/54. The rate of groundwater flow in the upper aquifer has been estimated to be 0.28 feet per day, or 103 feet per year. At this flow rate, it would take more than 35 years for contaminants to reach the nearest wetlands and 118 years for contaminants to reach the arsenal boundaries. These estimated time periods do not account for any potential

retardation or biodegradation effects, which would slow the movement of contaminants even further.

- Groundwater contamination will migrate laterally outward and vertically downward from the source of contamination at RSA-55/54, and therefore become less concentrated and less toxic with increasing distance from the site.

- Human health risks associated with current concentrations of contaminants at RSA-55/54 are just marginally above acceptable levels. As contaminants move away from RSA-55/54 and become less concentrated, they will not present an unacceptable risk.

- Chlorobenzene and benzene are both readily biodegradable when dissolved oxygen is present in groundwater. Some destruction of contaminants could occur without any active intervention.

Although the preferred Alternative 5 does not comply with the technical requirements of all applicable or relevant and appropriate state and federal regulations, it is nevertheless protective and cost-effective.

The intent of the RCRA closure requirements is to prevent direct exposure to hazardous substances left in place, and indirect exposure to hazardous substances that migrate from soil or waste materials to groundwater. The intent of the Alabama Groundwater Protection Program is to prevent human and ecological exposures to contaminated groundwater. The preferred Alternative 5 satisfies the intent of both of these regulations, although it provides the protections in a different but more cost-effective manner. Direct exposures to contaminated soils and landfill wastes are prevented by restricting access to the site through fencing. Restrictions on groundwater use at RSA-55/54 coupled with the implementation of a groundwater monitoring program will protect human and ecological receptors from exposure to contaminated groundwater.

STATUTORY DETERMINATION

The preferred alternative provides the best balance in achieving the goals of the five evaluation criteria. Based on the information available at this time, the AMCOM, the EPA, and the ADEM believe the preferred alternative would be protective of human health and the environment and would be cost effective. The preferred alternative utilizes permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable.

The preferred alternative would not satisfy the statutory preference for treatment as a principal element of the remedial action because treatment of the principal threats at the site was not found to be practicable. The large size of the landfill precludes a remedy in which soil contamination could be excavated and treated effectively. Extraction and treatment of contaminated groundwater would provide no additional protection to human health or the environment over the preferred alternative.

GLOSSARY

ADEM	Alabama Department of Environmental Management
AMCOM	U.S. Army Aviation and Missile Command
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DDT	dichlorodiphenyltrichloroethane
EPA	U.S. Environmental Protection Agency
RCRA	Resource Conservation and Recovery Act
RSA-55/54	Closed Sanitary and Industrial Landfill

THE COMMUNITY'S ROLE IN THE SELECTION PROCESS

The AMCOM, the EPA, and the ADEM solicit input from the community on the Proposed Plan for RSA-55/54. The AMCOM has set a public comment period from October 20 to November 18, 1997 to encourage public participation in the selection process. The comment period includes one public meeting, at which time the AMCOM will present the Interim Proposed Plan, answer questions, and accept both oral and written comments.

A public meeting is scheduled for November 4, 1997 at 4:00 p.m. at the Huntsville/Madison County Public Library, 915 Monroe Street, Huntsville, Alabama. Comments from the public will be summarized and responses will be provided in the Responsiveness Summary section of the Interim Record of Decision. To send written comments or obtain further information, contact:

Commander
U.S. Army Aviation and Missile Command
Attn: AMSAM-PA (Ms. Pam Rogers)
Redstone Arsenal, Alabama 35898-5020

Tel: (205) 842-0561
Fax: (205) 955-0133

E-mail: "rogers-ps@redstone.army.mil"

RESPONSE TO COMMENTS
PROPOSED PLAN FOR THE INTERIM RECORD OF DECISION
AT OPERABLE UNIT 6 FOR RSA-55/54
REDSTONE ARSENAL, ALABAMA

Comments of EPA dated September 17, 1997

Comment 1: **Page 1, second column, last paragraph: Suggested changes are similar to those on the RSA48 Proposed Plan, "The proposed plan presents an interim remedy because an assessment has yet to be completed to determine the potential cumulative risks to wildlife exposed to contaminants present from all sites within Operable Unit 6." The remaining portions of that section are excellent.**

Response 1: Done.

Comment 2: **I suggest conducting a word-search on the word "not". If "not" is used to say 'something is not completed' or 'something is not finished' change to the wording to say 'something has yet to be completed or yet to be finished'.**

Response 2: Done.